10 -06-00

NEW UNITED STATES UTILITY PATENT APPLICATION
under 37 C.F.R. 1.53(b)

Atty. Docket No. 4807.00003

CERTIFICATE OF EXPRESS MAILING UNDER 37 C.F.R. § 1.10: The undersigned hereby certifies that this United States Patent Application and all papers noted herein as being attached, are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" Service under 37 C.F.R. § 1.10 today, **October 5, 2000**, and is addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231.

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Assistant Commissioner for Patents
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Washington, D.C. 20231

Enclosed herewith is a new patent application and the following papers:

First Named Inventor (or application identifier): Cloonan, et al.

Title of Invention: Method and Apparatus for Decreasing Cable Installation Time and Cable Installation Faults

1. ■ Specification __22__ pages (including specification, claims, abstract) / __27__ claims (__3__ independent)

2. ■ Declaration/Power of Attorney is:
   - ■ attached in the regular manner.
   - ☐ NOT included, but deferred under 37 C.F.R. § 1.53(f).

3. ■ __4__ Distinct sheets of ☐ Formal ■ Informal Drawings

4. ☐ Preliminary Amendment.

5. ☐ Information Disclosure Statement
   - ☐ Form 1449
   - ☐ A copy of each cited prior art reference

6. ■ Assignment with Cover Sheet.

7. ☐ Priority is hereby claimed under 35 U.S.C. § 119 based upon the following application(s):

Country	Application Number	Date of Filing (day, month, year)

8. ☐ Priority document(s).

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9.   ■   Statement Claiming Small Entity Status.

10. ☐   Microfiche Computer Program (Appendix).

11. ☐   Nucleotide and/or Amino Acid Sequence Submission.
    ☐   Computer Readable Copy.
    ☐   Paper Copy (identical to computer copy).
    ☐   Statement verifying identity of above copies.

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12.   Calculation of Fees:

FEES FOR	EXCESS CLAIMS	FEE	AMOUNT DUE
Basic Filing Fee (37 C.F.R. § 1.16(a))			$710.00
Total Claims in Excess of 20 (37 C.F.R. § 1.16(c))	7	18.00	$126.00
Independent Claims in Excess of 3 (37 C.F.R. § 1.16(b))	0	80.00	$0.00
Multiple Dependent Claims (37 C.F.R. § 1.16(d))	0	260.00	$0.00
Subtotal - Filing Fee Due			$836.00
		MULTIPLY BY	
Reduction by 50%, if Small Entity (37 C.F.R. §§ 1.9, 1.27, 1.28)		0.5	$418.00
TOTAL FILING FEE DUE			$418.00
Assignment Recordation Fee (if applicable) (37 C.F.R. § 1.21(h))	1	40.00	$40.00
GRAND TOTAL DUE			**$458.00**

13.   PAYMENT is:
  ■   included in the amount of the GRAND TOTAL by our enclosed check. A general authorization under 37 C.F.R. § 1.25(b), second sentence, is hereby given to credit or debit our Deposit Account No. 01-0850 for the instant filing and for any other fees during the pendency of this application under 37 C.F.R. §§ 1.16, 1.17 and 1.18.
  ☐   not included, but deferred under 37 C.F.R. § 1.53(f).

14.   All correspondence for the attached application should be directed to:

Banner & Witcoff, Ltd.
Ten South Wacker Drive, Suite 3000
Chicago, IL 60606-7407
Telephone: (312) 715-1000
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15.   Other: _____

Date: October 5, 2000   By: Joseph P. Krause
                                                 Reg. No. 32,578

JPK/caj

Applicant or
Patentee: Thomas J. Cloonan; Daniel W. Hickey; Thomas J. Mack; David R. Johnson

Serial or   Filed or
Patent No.   _____   Issued: _____

Title: _____ Method and Apparatus for Decreasing Cable Installation Time and Cable Installation Faults _____

VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS
(37 C.F.R. §1.9(f) AND § 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am

[ ]   the owner of the small business concern identified below:

[X]   an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN   Cadant, Inc. _____

ADDRESS OF CONCERN   4343 Commerce Ct., Suite 207 _____

                                       Lisle, Illinois 60532 _____

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 C.F.R. §121.12, and reproduced in 37 C.F.R. §1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time, or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled Method and Apparatus for Decreasing Cable Installation Time and Cable Installation Faults _____

by inventor(s) _____ Thomas J. Cloonan; Daniel W. Hickey; Thomas J. Mack; David R. Johnson _____

described in

[X]   the specification filed herewith

[ ]   Application Serial No. , filed .

[ ]   Patent No. , issued .

If the rights held by the above identified small business concern are not exclusive, each individual concern or organization having rights in the invention must file verified statements averring to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR § 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR § 1.9(d), or a nonprofit organization under 37 CFR § 1.9(e).

1

Each person, concern or organization having any rights to the invention is listed below:
___ No such person, concern or organization exists.
_X_ Each such person, concern or organization is listed below.

FULL NAME ___Cadant, Inc._____

ADDRESS _____4343 Commerce Ct., Suite 207, Lisle, Illinois 60532_____

[ ] Individual   [X] Small Business Concern   [ ] Nonprofit Organization

FULL NAME _____

ADDRESS _____

[] Individual   [] Small Business Concern [] Nonprofit Organization

Separate verified statements are required from each named person, concern or organization having rights in the invention averring to their status as small entities. (37 CFR § 1.27).

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 C.F.R. § 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing therein, or any patent to which this verified statement is directed.

~~Venkata C. Majeti~~ THOMAS J CLOONAN
NAME OF PERSON SIGNING

~~President and CEO~~ CTO
TITLE IN ORGANIZATION

4343 Commerce Ct., Suite 207, Lisle, Illinois 60532
ADDRESS OF PERSON SIGNING

Thomas J. Cloonan
Signature

9-15-00
Date

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METHOD AND APPARATUS FOR DECREASING CABLE
INSTALLATION TIME AND CABLE INSTALLATION FAULTS

Field of the Invention:

5   The present invention relates to a method and apparatus for decreasing cable installation

times and cable installation faults in a cable modem termination system.

Background of the Invention:

The world is on the verge of a revolution that promises to change the way the Internet

works and it is guaranteed to change the way the entire world communicates, works and plays.

10   The revolution is the introduction of quality of service (QoS) to the Internet.   This QoS

revolution is already beginning, because most computer networking products (switches and

routers) have already added some type of QoS to their feature sets. Unfortunately, there are many

different forms of QoS from which to choose and they are not all compatible with one another.

Different standards committees (DiffServ, RSVP, MPLS, etc.) are still deciding which of many

15   different QoS proposals will actually be used in the Internet, and hybrid solutions will likely be

developed in the very near future that will enable the QoS revolution.

The change is important, because it will eliminate the current Internet routing model that

provides the same "best effort" service to all users, all packets, and all traffic flows. When QoS

is enabled in a ubiquitous, end to end fashion across the Internet, differentiated services will be

20   permitted, and all packets will be treated differently. High priority packets will be routed with

lower latency and lower jitter, while low priority packets may experience more delay and jitter.

The throughput needs of each application will determine the priority associated with its

corresponding traffic flows, and it is likely that advanced application programs of the future will

dynamically change the priority of traffic flows to match the very needs of the user through the entire duration of the session.

Since all packets will not be passed using the same priority level, it follows that all packets cannot be billed using the same charges in the future either. Future Internet users are likely to pay differently for different classes of service, and they may even be billed on a usage basis, e.g., per-minute, per packet, or per byte, similar to the billing schemes used for long distance telephone service today. The use of high priority traffic flow for an application will undoubtedly result in higher Internet usage costs than the use of low priority traffic flows and service level agreements (SLAs) between the Internet user and their service provider will detail the available priority and throughputs in and their associated costs. These changes in the Internet billing model represent an incredible revenue generating potential for access providers that can provide and bill for these new differentiated services, and multiple system operators (MSOs) are key members of this group.

MSOs are positioned in an ideal location within the Internet to play a major role in the QoS revolution, and they will be able to capitalize on the resulting changes. This is because the MSOs are positioned to act as the QoS gatekeeper into the future Internet. They can perform this function because they have access to each subscriber's service level contract and can appropriately mark the priority of all packets that are injected into the Internet by their subscribers. In fact, the MSOs head end equipment, the cable modem termination system CMTS is actually the first piece of trusted equipment not owned by the subscriber to which subscriber packets must pass on their way to the Internet. The CMTS is positioned at the head end office and it provides basic connectivity between the cable plant and the Internet. Figure 1 illustrates a simplified cable data system 10 with a CMTS 30. The CMTS 30 is connected through Internet

link 40 to the Internet 20. The CMTS 30 is also connected through various cable links 50 to a

plurality of subscribers 60.

The MSO also provides customer subscription packages and is able to offer (and bill for)

many different subscriber service levels. In addition, if the CMTS equipment permits it, the

5   MSO will also be able to offer dynamic service level upgrades to its subscribers. Features

contained within an MSOs CMTS must provide most of these revenue generating QoS

capabilities. This will result in even greater increases in revenues if the MSOs can maintain

adequate counts on usage of different services levels consumed by its subscribers.

As set forth above, this CMTS provides basic connectivity between the cable plant and

10   the local area network that interfaces to an edge router on the Internet. The CMTS is responsible

for appropriately classifying, prioritizing, flow controlling, queuing, scheduling and shaping all

the traffic flows between cable data subscribers and the Internet. As a result, this type of service

experienced by the cable data subscribers will primarily be determined by the features in the

CMTS core.

15   When selecting a CMTS for cable data deployment or expansion, MSOs have several

different options from which to choose. The choice is complicated by a broad spectrum of prices

and features such as reliability levels, ease of use, controllability, manageability, observability,

support for various interfaces, support for various counts and measurements, support for

proprietary features and feature upgrades, vendor service levels, etc. The CMTS selection process

20   is even further complicated by the fact that a particular set of CMTS features that are required in

one head end area may actually be undesirable in a different head end area because subscriber

usage patterns and traffic profiles within the one region may be entirely different from those in

another region.

Nevertheless, there is one CMTS feature that will undoubtedly be desirable and necessary

for most of the head end that almost all of the MSOs as cable data service expands into the

future. This feature is scalability. When referring to the size of a CMTS, the term scalable can

be assigned two different meanings. According to one definition, a scalable CMTS should allow

5   growth along a graduated path from very small sizes to very large sizes without imparting any

large costs increments onto the MSO at any step along the graduated growth path. According to

a second definition, a scalable CMTS should be capable of reaching the maximum capacity for

size permitted by the underlined CMTS technology. For many reasons, MSOs might want to

look for both of these scalability features when making their CMTS purchasing decisions.

10   The first of these features (graduated growth) is desirable in a CMTS because cable data

services almost always greeted with incredible popularity when ever it enters a new subscription

area. This typically leads to the dramatic increase in subscribers within a very short interval of

time. To accommodate the sporadic usage increases, the CMTS must be able to rapidly increase

the number of downstream and upstream channels being delivered to the subscribers. Any delay

15   in this channel increase may force an MSO to temporarily over subscribe the existing cable data

channels. The densely packed subscribers on the over subscribed channels are likely to complain

and/or lose interest in the service giving the competitors with cable data service a chance to steal

subscribers.

Even an established cable data service area where the upstream and downstream channel

20   counts have been nicely matched to the current subscriber base, the subscriber demand for

bandwidth will continually increase over time as new bandwidth hungry Internet applications are

introduced. This increase in bandwidth demand will manifest itself as an increase in the

subscription rate for higher service level agreements and that will force the MSOs to pack fewer

subscribers on a given channel, and that will again require the CMTS to be able to rapidly increase the number of channels even if it is providing to the same number of customers. This illustrates a second reason why graduated growth is a desirable feature in a MSOs CMTS.

The second definition of scalability (maximum capacity) is also a desirable feature within a CMTS, because the ultimate subscriber rates for cable data service are likely to approach the 20-25% levels within these established service areas. Thus, a typical head end supporting 60,000 cable TV subscribers may need to support up to 15,000 cable data subscribers. If future bandwidth demands limit the MSOs to only 500 cable data subscribers per downstream channel, then the maximum equipped CMTS should be capable of supporting up to 30 downstream channels. In addition, if the typical head end requires 4 upstream channels to be associated with each downstream channel, then the maximally equipped CMTS should be capable of supporting up to 120 upstream channels. Unfortunately, accommodating all of these (30+120) =150 connections out of the CMTS will require a large amount of cabling. Each of the 150 required connections must be transported on a coaxial cable. In a well designed system with high availability, the system repair time should be kept to a minimum, so the bundle of cables emanating from the CMTS will likely be coming from the backside of the system chassis to allow office technicians to rapidly replace faulty circuit cards by pulling them off the front side of the system chassis without having to remove and restore the cabling that emanates from the backside of the chassis.

Another feature that will undoubtedly be required at most feature at CMTS products is flexibility. In particular, CMTS' must be able to accommodate the many different traffic profiles throughout the usage area. This implies that the equipment of the CMTS chassis will be different

with each head end office because the equipment must be customized to match the input demands of the customers connected to each head end.

As an example, in some areas, this may require circuit cards that require one upstream channel for each downstream channel also known as 1D:1U circuit cards. In other areas, this may require circuit cards support for upstream channels for each downstream channel which is also known as a 1D:4U circuit card. In still other areas, this may require circuit cards that support each upstream channels with each downstream channel also known as a 1D:8U circuit card. Many other types of useful circuit cards can also be envisioned including, but not limited to, 1D:3U circuit cards, 2D:8U circuit cards, 2D:4U circuit cards, and 2D:2U circuit cards. In general, any type of circuit cards of type nD:nU can be envisioned wherein m and n are non-negative integers.

To make matters even worse, the CMTS chassis within a single head end office is likely to require several different types of front circuit cards to accommodate different traffic profiles on different cables leaving the head end office. Thus, a single CMTS might need to be equipped with b 1D:1U circuit cards, c 1D:4U circuit cards, d 1D:8U circuit cards, e 1D:3U circuit cards, f 2D:8U circuit cards, g 2D:4U circuit cards, h 4D:4U circuit cards and i MD:NU circuit cards where b,c,d,e,f,g,h,i, m and n are non-negative integers.

Given that backside cabling is likely to become more popular over time, as high availability CMTS' become more popular, it is apparent that a fundamental problem will develop. The problem is centered around the difficulties that will be encountered by the cable office technicians that are responsible for correctly installing and maintaining the many cables that must be connected to the backside of the high capacity next generations CMTS chassis. Correct connection for the many cables to the backside of the chassis is itself a difficult task. But

this task is exasperated by the inclusion of many different circuit card types that can be equipped in the front side of the chassis. When connecting the cables the office technician will typically not be able to see the type of circuit cards that are equipped in the front side of the chassis. As a result, correct connection of the backside cable will require the technician to remember or record

5   the circuit card equippage (circuit card type and circuit card placement in the front card of the chassis).

Unfortunately, in the hectic environment of a cable head end office, this approach is prone to cabling errors. In its most benign form, a cabling error will merely result in delayed delivery of the service to subscribers while the incorrect system operation that results from the

10 incorrect cabling is diagnosed. In even more catastrophic scenarios, the incorrect cabling can literally damage the equipment on either end of the cable resulting in increased equipment costs and delayed delivery of the service to subscribers. In either case, the result is not desirable, so a technique for reducing the possibility of these cabling errors is likely to be a benefit to the technician and to the head end office.

15 **Summary of the Invention**

A method and apparatus for decreasing cable installation times and cable installation faults is disclosed. According to one embodiment of the present invention, the back panel of the CTMS has a light source, for example an LED associated with each connector on the back plane. When a circuit card is plugged into the front plane of the CMTS the card activates the light

20 source on the back plane to indicate whether an active channel is connected to the connector and what type of channel the active channel is.

According to one embodiment of the present invention, an apparatus for a cable modem termination system having front and rear sides is disclosed wherein the front side accepts

electronic circuit cards and the electronic signals from which where to be transferred to connectors mounted at the rear side. A panel coupled to the rear side of the CMTS has at least first and second openings therethrough. A first connector extends through the first opening is operationally coupled to a first electronic circuit card installed in the CMTS at the front side of

5   the CMTS. A light source is visible through the second opening in the panel to illuminate the status of what should be connected to the connectors on the back panel.

Brief Description of the Drawings

The teachings of the invention can be readily understood by considering the following detailed description with conjunction with accompanied drawings, in which:

10   Figure 1 illustrates an exemplary cable data system;

Figure 2 illustrates a CMTS according to one embodiment of the invention;

Figure 3 illustrates a front plane of a CMTS according to one embodiment of the invention;

Figure 4 illustrates a back plane of a CMTS according to one embodiment of the present

15   invention;

Figure 5 illustrates a side view of a CMTS according to one embodiment of the invention; and

Figure 6 illustrates a side view of a CMTS according to one embodiment of the invention.

Detailed Description

20   FIG. 2 illustrates an embodiment cable modem termination system (CMTS) apparatus according to one embodiment of the invention. The CMTS apparatus of FIG. 2 is comprised of a cable interface (201) that is coupled to a buffer circuit (205). The buffer circuit (205) is coupled to an Ethernet interface (210). In the preferred embodiment, each of the individual circuits (201,

205, and 210) reside physically on separate circuit boards. In alternate embodiments, any circuits having substantially the same function can reside on one circuit board or even one integrated circuit. In other words, the present invention is not limited to three separate circuit boards.

The cable interface (201) is responsible for interfacing the CMTS to the home cable

5   modem apparatus. The cable interface (201) also provides the functions of modulation and demodulation.

The cable interface circuit is comprised of a downstream packet flow path and an upstream packet flow path. The downstream packet flow path is comprised of a data throughput monitor (220) that is coupled to a flow limiter (215). The data throughput monitor (220) has an

10   input that is coupled to the buffer circuit (205) from which the data packets flow and a feedback from the upstream path. The feedback from the upstream path is to allow a first CM to talk with other CMs. The data throughput monitor (220) has the task of determining the rate of data packet flow.

In the preferred embodiment of the CMTS, the downstream data packet flow rate is

15   typically either 30 or 40 Mbps for each 6 MHZ channel, using QAM techniques. Alternate embodiments use other flow rates. The cable company decides which data packet flow rate depending on the outcome desired by the company. The lower data rate is less susceptible to noise while the higher data rate can include more data per unit of time for the customers.

The data packet flow rate signal is fed into the flow limiter (215). This signal controls the

20   flow limiter function. If the flow is greater than a predetermined level, T_{max}, the data packet flow can be limited. The flow limiter (215) reduces the data rate by dropping packets until the flow is reduced to below T_{max}.

Another input to the flow limiter (215) is the "limiting type" input. This control input is set by the cable company depending on how strict they wish a customer to adhere to the rules. If the "limiting type" input is set to "soft-limiting", the flow limiter (215) allows the data rate to go above the set data rate by a predetermined amount without dropping any packets.

5   Some cable companies may strictly limit a customer to T_{max}. In this case, the "limiting type" control input is set to "hard-limiting". If the data rate goes over the set hard limit, the flow limiter (215) drops any packets that force the customer to exceed T_{max}. The output of the flow limiter (215) is coupled to the cable that runs to the customers' cable modems.

The output of the flow limiter (215) is input to the modulator (255). This block (255) performs the QAM needed to transmit the data to the CMs.

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The upstream data path is comprised of a demodulator and filter (260) that converts the QAM signal into data bits in order to be processed by the other blocks in the upstream path. The demodulated data bits are input to a data throughput monitor (225) that is coupled to the upstream port from the customer's CM. This data throughput monitor (225) has the same functionality as the downstream monitor (220) of monitoring the data rate but in the upstream direction to the Internet.

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In the preferred embodiment, the upstream data rate can be in the range of 320 kb to 10.24 Mbps. Alternate embodiment use other rates.

The upstream data throughput monitor (225) is coupled to a flow limiter (230). This flow limiter has similar functionality to the flow limiter (215) in the downstream path. The upstream path flow limiter (230) has the data rate input from the data throughput monitor (225) as well as the "limiting type" control input that, in the preferred embodiment, is set to either "hard-limiting" or "soft-limiting" depending on the cable company rules. As in the downstream flow limiter

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(215), the upstream flow limiter, depending on the "limiting type" input, drops all packets that

force the customer to exceed T_{max}.

The upstream path further comprises a congestion control block (235) that is coupled to

the upstream data path out of the flow limiter (230). The data packets from the upstream data

5   path flow through the congestion control block (235) to the buffer circuit (205). The function of

the congestion control block (235) is to drop packets when the buffer depth is reaching a

maximum point. By dropping the packets before they reach the buffer, the buffer will not

overflow.

In order to accomplish the task of congestion control, the congestion control block (235)

10   has control inputs that are used to determine when to drop packets and which packets to drop. In

the preferred embodiment, these control inputs include the data rate signal from the upstream

data throughput monitor (225), a buffer depth signal from the buffer (205), and a priority signal.

The data rate signal from the upstream data throughput monitor (225), as described

above, quantizes the data rate and feeds that value to the congestion control block (235). The

15   buffer circuit depth signal from the buffer circuit (205) instructs the congestion control block

(235) as to the depth of the buffer. In other words, if the buffer (205) is 75% full, the buffer depth

signal instructs the congestion control block (235) of this.

The priority signal that is input to the congestion control block (235) informs the

congestion control of the priority of each packet. This is important in determining which packets

20   to drop.

A group of packets is assigned a priority based on the customer's level of service plan. If

the customer has signed up for the basic service plan and paid the smallest fee for the most basic

service, his packets are assigned a low priority. This priority is embedded in a packet

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identification that is assigned to the group of packets and is decoded when the group of packets enters the cable interface.

If the customer has signed up for the premium service plan with the cable company, his packets are assigned the highest priority. If the customer has signed up for any service plans that are in between the premium and the basic plans, this priority is also assigned to each packet. As described before, the priority is added to the packet identification for a particular group of packets.

A customer may also decide to dynamically change his service level for a given session. In this case, different packet groups from that particular customer will have different priorities assigned to different packet identifications.

As described subsequently in other figures, the congestion control block (235) of FIG. 2 uses the priority assigned to a group of packets to determine how to process that particular group of packets. The output of the congestion control block is input to the buffer circuit's upstream data flow input.

The buffer circuit (205) stores the packets until the Ethernet circuit (210) has time to process that packet. The packets are fed from the buffer circuit (205) to the Ethernet circuit (210) as more processing time is freed up.

The downstream path of the Ethernet circuit (210) is comprised of a data throughput monitor (250) that is coupled to the connection to the Internet. This monitor (250) provides substantially the same function as the previously described data throughput monitors on both the upstream and downstream paths.

The data packets from the Internet flow from the data throughput monitor (250) to the Ethernet's circuit flow limiter (245). This flow limiter (245) has substantially the same

functionality as the above described flow limiters. This flow limiter also has the same inputs as described previously: the quantized data rate and the "limiting type" control input.

The data packets flow from the flow limiter (245) to the congestion control block (240). As in the upstream congestion control block (235), the Ethernet's downstream congestion control

5   block (240) has the three control inputs to determine which packets to drop: the quantized data rate, the buffer depth signal, and the packet priority signal. The congestion control block then drops a particular packet based on these control signals.

The downstream data flows from the congestion control block to the buffer circuit (205). The buffer circuit (205) stores the packets until the cable interface circuit has the processing time

10   to work on additional packets.

The buffer circuit (205) is comprised of 128 MB of RAM, in the preferred embodiment. Alternate embodiments use other values of RAM or even other types of memory instead of RAM. The alternate types of memory include hard drives or other types of temporary memory.

Most of the functions illustrated in FIG. 2 may be implemented in various ways. These

15   functions can be performed in software by a processor or multiple processors performing each function. Each function can also be implemented in discrete logic hardware, a digital signal processor, or some other form of programmable logic.

According to one embodiment of the invention, the CMTS is designed so that all of the circuit cards are plugged into the front of the CMTS chassis and all of the cables are connected to

20   the back of the CMTS chassis. As illustrated in Figure 3, a plurality of slots 304 are provided on the front of the CMTS chassis 302 for receiving a plurality of circuit cards. As noted above, different types of circuit cards can be used to accommodate different traffic profiles. The back of the CMTS chassis according to one embodiment of the invention is illustrated in Figure 4. The

back of the CMTS chassis has a slot 402 with connectors for each of the available slots 304 on

the front of the CMTS chassis. In each slot, a plurality of connectors are provided. In this

example, 10 connectors are provided for each slot. It will be understood that any number of

connectors could be provided in each slot and the invention is not limited to the embodiment

5   illustrated in Figure 4. However, for ease of operation and flexibility, the number of connectors

provided for each slot should correspond to the maximum number of channels that may be

required by a circuit card plugged into the front of the CMTS chassis.

According to one embodiment of the invention, a label indicating whether the connector

is for an upstream channel of a downstream channel can optionally be placed near each

10   connector. In Figure 4, labels D0 and D1 are used to designate downstream channels while U0,

U1, U2, U3, U4, U5, U6, and U7 are used to designate upstream channels, but the invention is

not limited thereto. A light source is also placed next to each connector. The light source can be

one of many different devices, such as, for example, light emitting diodes (LEDs), light pipes,

incandescent lamp, optical fiber, etc. The light sources can be color coded so as to indicate the

15   type of channel the connector is associated with. For example, one color such as amber,

illuminated on the LED can indicate an active upstream channel is connected to the connector,

while a second color, such as green, illuminated on the LED can indicate an active downstream

channel is connected to the connector. In this embodiment, if the LED is not illuminated this

condition indicates that the channel associated with the connector is not active.

20   In other embodiments, light pipes can be used to display the appropriate color next to

connectors associated with active channels. As illustrated in Figure 5, for example, an amber

light source 502 can be connected to light pipes 506 going to one or more light displays next to

the connectors on the back of the CMTS chassis and a green light source 504 can be connected to

light pipes 508 going to one or more light displays on the back of the CMTS chassis.

Alternatively, each connector can have two light sources associated with it, so that any

connector on the back-side of the CMTS chassis can be connected to any type of channel on the

5　front-side circuit boards. Furthermore, more than 2 colors and/or light sources can be used to

differentiate between more than 2 types of channels. For example, a chassis that supports both

quad and octal Ethernet circuit cards in the front-side of the CMTS chassis could use this lighting

technique to illuminate either four or eight of the eight LEDs that would be displayed on the

back-side of the CMTS chassis.

10　Alternatively, certain connectors on the back-side of the CMTS chassis can be pre-

defined to be used only for upstream channels, while other connectors can be pre-defined to be

used only for downstream channels. The connectors used only for upstream channels would then

require single color LEDs with, for example, the color amber, whereas the connectors used only

for down stream channels would then require single color LEDs with, for example, the color

15　green.

When a circuit card is plugged into the front of the CMTS chassis, the CMTS determines

which channels are active and what type of channel it is. A controller 602, illustrated in Figure 6,

is connected to the slots provided in the front of the CMTS chassis. The controller 602

determines whether each channel is active and the type of active channels using known

20　techniques. The controller 602 then sends signals to the LEDs on the back of the CMTS chassis

associated with the active channels to illuminate. In addition, the signals may also indicate the

color of illumination. In the embodiment illustrated in Figure 5, the controller 602 sends signals

opening and closing the appropriate light pipes 506 and 508 to illuminate the appropriate light displays on the back of the CMTS chassis.

In another embodiment, the circuit card plugged into the front of the CMTS chassis can send signals to illuminate the LEDs on the back of the CMTS chassis associated with the active

5   channels. In addition, the signals may also indicate the color of illumination.

While exemplary systems and method embodying the present invention are shown by way of example, it will be understood, of course, that the invention is not limited to these embodiments. Modifications may be made by those skilled in the art, particularly in light of the foregoing teachings. For example, each of the elements of the aforementioned embodiments may

10   be utilized alone or in combination with elements of the other embodiments.

Cadant, Inc.
4807.00003 .

We claim:

1   1.   An apparatus for a cable modem termination system (CMTS) having front and rear sides,

2   said front side accepting electronic circuit cards, electronic signals from which are transferred

3   through connectors mounted at said rear side, said connector panel comprising:

4   a panel coupled to the rear side of the CMTS having at least first and second openings

5   there through;

6   a first connector extending through said first opening and operationally coupled to a first

7   electronic circuit card installed in the CMTS at the front side of the CMTS; and

8   a light source, visible through said second opening in said panel, the illumination status

9   of which is determined by said first electronic circuit card.

1   2.   The apparatus according to claim 1, wherein said first connector is a coaxial cable

2   connector.

1   3.   The apparatus according to claim 1, wherein said light source is remotely located from

2   said second opening.

1   4.   The apparatus according to claim 1, wherein said light source is comprised of at least one

2   light emitting diode.

1   5.   The apparatus according to claim 1, wherein said light source is an incandescent lamp.

1   6.   The apparatus according to claim 1, wherein said light source is comprised of an optical

2   fiber.

1   7.   The apparatus according to claim 1, wherein said light source is a light pipe, optically

2   coupling light from a light source to said second opening.

1   8.   The apparatus according to claim 1, wherein different colors are illuminated from the

2   light source to represent different types of channels.

1   9.   The apparatus according to claim 8, wherein a plurality of light sources are associated

2   with each connector, wherein each light source associated with a connector is illuminated in

3   different colors.

1   10.   A cable modem termination system (CMTS) having front and rear sides, said front side

2   accepting electronic circuit cards, electronic signals from which are transferred through

3   connectors mounted at said rear side, said CMTS comprising:

4   a panel coupled to the rear side of the CMTS having at least first and second openings

5   there through;

6   a first connector extending through said first opening an operationally coupled to a first

7   electronic circuit card installed in the CMTS at the front side of the CMTS; and

8   a controller connected to said first electronic circuit card for determining the status of

9   channels associated with said first electronic circuit card,

10   a light source, visible through said second opening in said panel, the illumination status

11 of which is determined by said controller.

1 11. The apparatus according to claim 10, wherein said first connector is a coaxial cable

2 connector.

1 12. The apparatus according to claim 10, wherein said light source is remotely located from

2 said second opening.

1 13. The apparatus according to claim 10, wherein said light source is comprised of at least

2 one light emitting diode.

1 14. The apparatus according to claim 10, wherein said light source is an incandescent lamp.

1 15. The apparatus according to claim 10, wherein said light source is comprised of an optical

2 fiber.

1 16. The apparatus according to claim 10, wherein said light source is a light pipe, optically

2 coupling light from a light source to said second opening.

1 17. The apparatus according to claim 10, wherein different colors are illuminated from the

2 light source to represent different types of channels.

1   18.   The apparatus according to claim 17, wherein a plurality of light sources are associated

2   with each connector, wherein each light source associated with a connector is illuminated in

3   different colors.

1   19.   A cable modem termination system (CMTS) having front and rear sides, comprising:

2   a plurality of slots on said front side for accepting at least one electronic circuit card;

3   a plurality of row of connectors on said rear side, wherein each row of connectors

4   corresponds to connectors associated with each slot on the front side;

5   at least one light source associated with each connector on the back side;

6   a controller connected to each slot, wherein when an electronic circuit card is inserted

7   into a slot the controller determines which channels are active and the type of channel required

8   by the electronic circuit card and sends signals regarding the illumination status of said at least

9   one light source associated with appropriate connectors.

1   20.   The apparatus according to claim 19, wherein said first connector is a coaxial cable

2   connector.

1   21.   The apparatus according to claim 19, wherein said light source is remotely located from

2   said second opening.

1   22.   The apparatus according to claim 19, wherein said light source is comprised of at least

2   one light emitting diode.

1   23.   The apparatus according to claim 19, wherein said light source is an incandescent lamp.

1   24.   The apparatus according to claim 19, wherein said light source is comprised of an optical

2   fiber.

1   25.   The apparatus according to claim 19, wherein said light source is a light pipe, optically

2   coupling light from a light source to said second opening.

1   26.   The apparatus according to claim 19, wherein different colors are illuminated from the

2   light source to represent different types of channels.

1   27.   The apparatus according to claim 26, wherein a plurality of light sources are associated

2   with each connector, wherein each light source associated with a connector is illuminated in

3   different colors.

Abstract of the Disclosure

A method and apparatus for decreasing cable installation times and cable installation faults is disclosed. The back panel of the CTMS has a light source, for example an LED associated with each connector on the back plane. When a circuit card is plugged into the front plane of the CMTS the card activates the light source on the back plane to indicate whether an active channel is connected to the connector and what type of channel the active channel is.
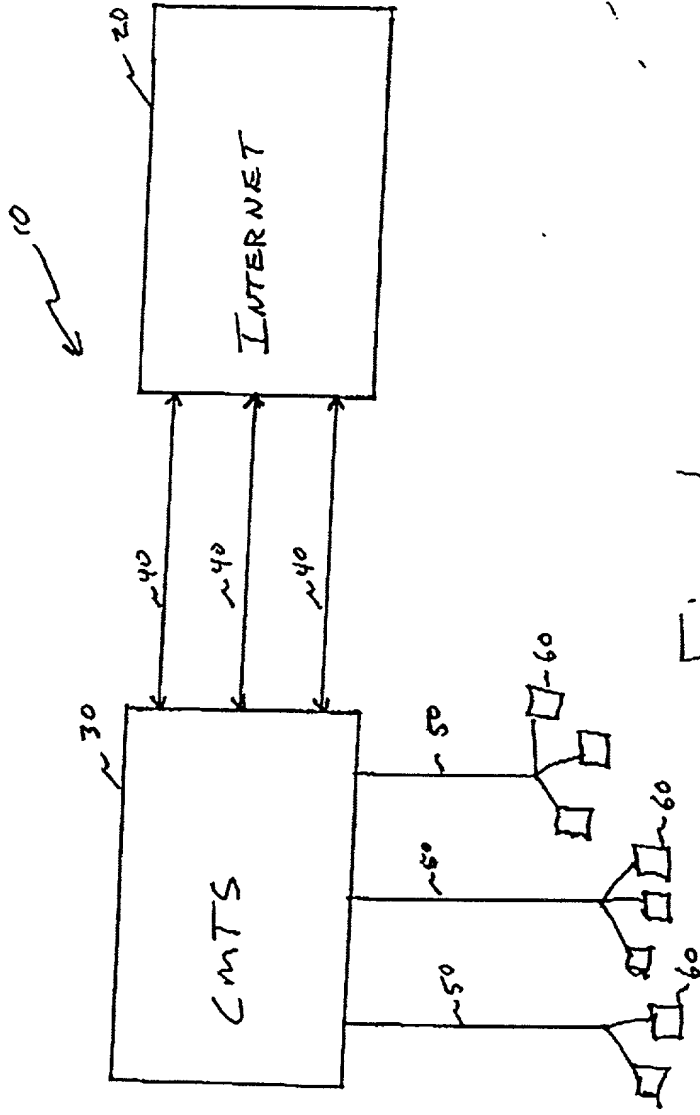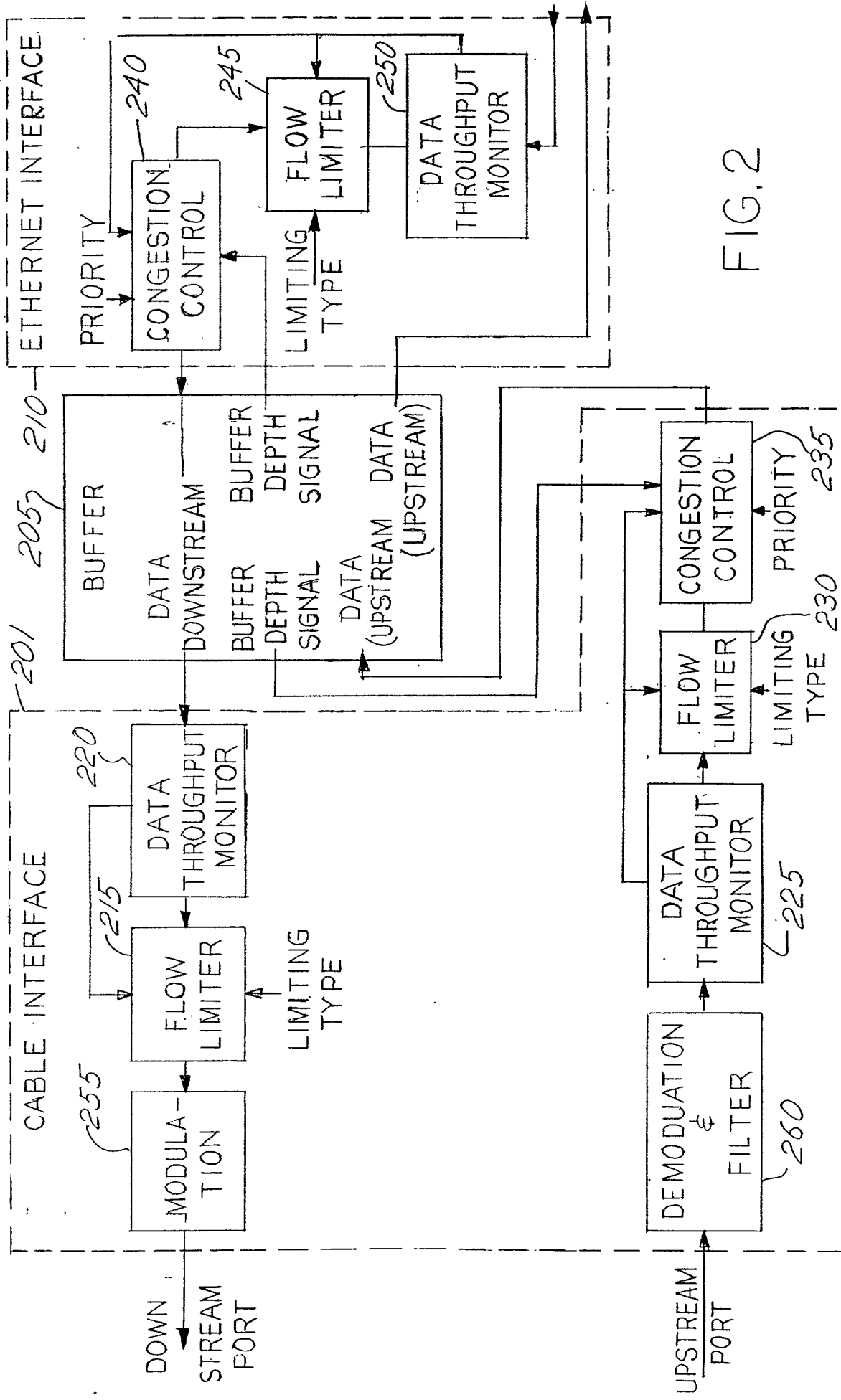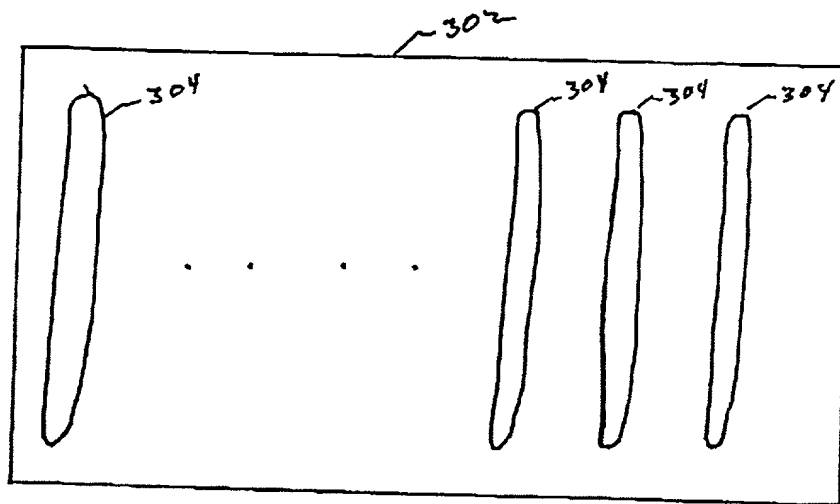
5

Fig. 1

FIG. 2

~302

~304 304 304 304

Fig. 3

Dx = Downstream port x
Ux = Upstream port x

16.8" (FITS IN 19" RACK)

SIMPLEX OR DUPLEX -48 V POWER SUPPLY

| SUPPLY A | SUPPLY B |

EXHAUST

402

D0 D1 U0 U1 U2 U3 U4 U5 U6 U7

Un/z LED

FILTER

AIR INTAKE FANS

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

1D-8U
1D-4U
2D-8U
2D-4U
2D-2U
Spare for slot 6&7

Fig. 4

Fig. 5

CONTROLLER

602
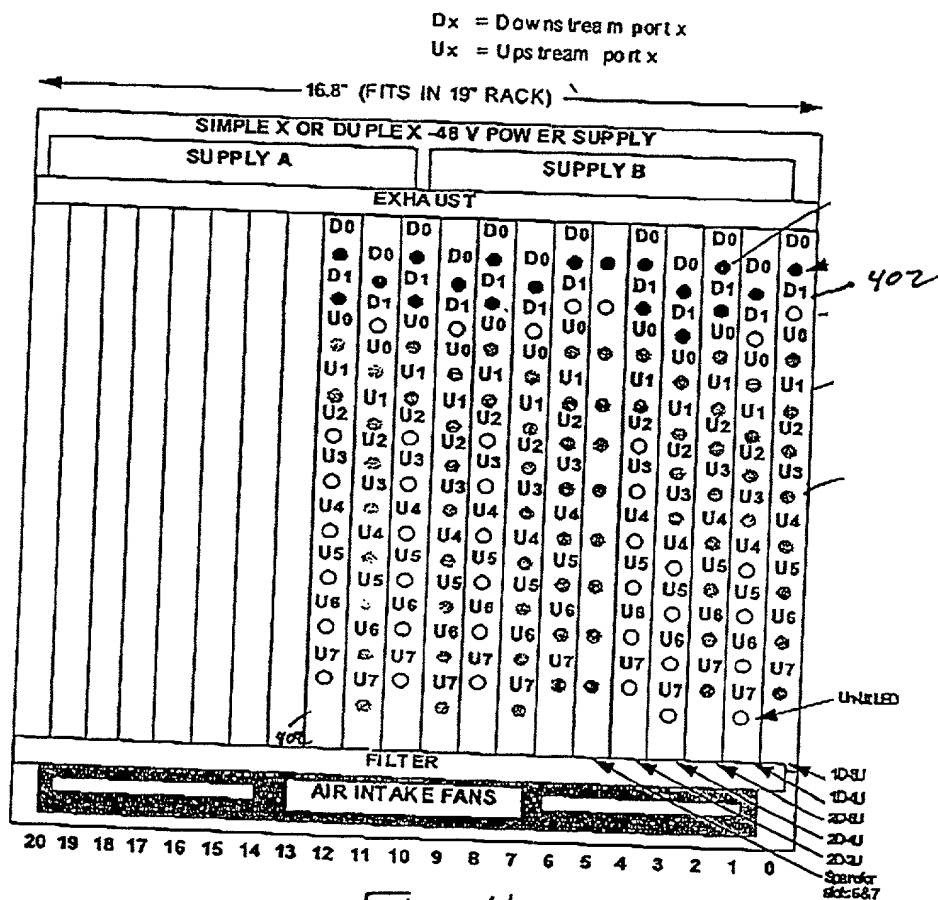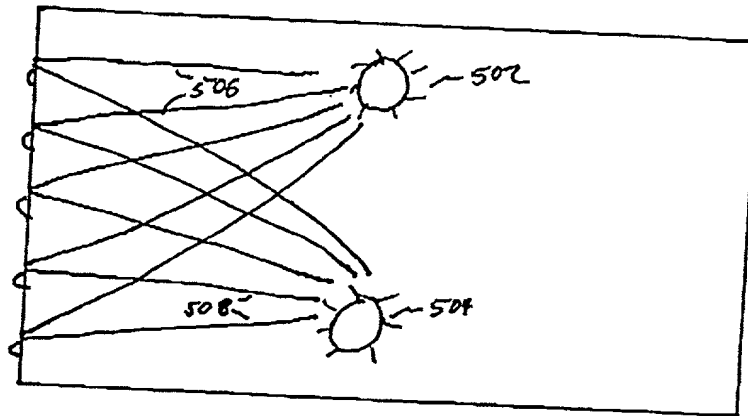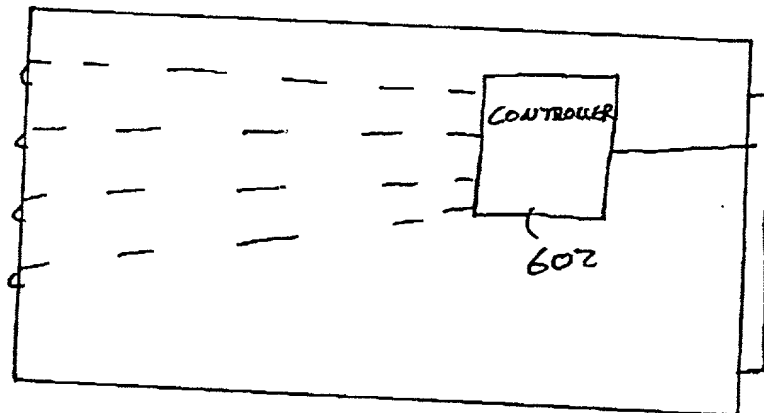
Fig. 6

DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Method and Apparatus for Decreasing Cable Installation Time and Cable Installation Faults

the specification of which is attached hereto unless the following space is checked:

_____   was filed on _____ as United States Application Serial Number or PCT International Application Number_____ and was amended on_____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s):

	Number	Country	Day/Month/Year Filed	Priority Not Claimed
1.				☐
2.				☐

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

	Application Number	Filing Date
1.		
2.		

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

	Application Number	Filing Date	Status — patented, pending, abandoned
1.			
2.			

I hereby appoint the following attorneys and agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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-3-